CERTIFICATION OF TRANSLATION

I, Heegyung Suh, an employee of Y.P.LEE, MOCK & PARTNERS of The Cheonghwa Bldg., 1571-18 Seocho-dong, Seocho-gu, Seoul, Republic of Korea, hereby declare under penalty of perjury that I understand the Korean language and the English language; that I am fully capable of translating from Korean to English and vice versa; and that, to the best of my knowledge and belief, the statements in the English language in the attached translation of the priority document (Korean Patent Application No. 01-7845), consisting of 21 pages, have the same meanings as the statements in the Korean language in the original document, a copy of which I have examined.

Signed this 26 day of 11, 2004

Heegyung Suh

Heegyung Suh

ABSTRACT

[Abstract of the Disclosure]

Abstract of the Disclosure

A method and an apparatus for automatically controlling the optimum output of a laser diode are provided. The apparatus automatically controls the output of a laser diode based on the results of a comparison between the current power value of an optical signal output from a laser diode and a basic power value. The apparatus includes: a sampler for sampling the current power value output from the laser diode; a register unit for storing the output of the sampler; a basic register unit for storing a basic value; an operation unit for outputting a target output value applied to the laser diode based on the current power value and the basic power value stored in the register unit and the basic register unit; and a pulse generator for generating a control signal controlling the storing timing of the register unit based on recording data to be recorded by the laser diode. The apparatus can be effectively adapted to an optical recording/regenerating apparatus of high speed and high capacity, and can be attributed to the performance improvement and downsizing of the optical recording/reproducing apparatus.

[Representative Drawing]

FIG. 4

SPECIFICATION

[Title of the Invention]

Method and apparatus for automatically controlling output of laser diode

[Brief Description of the Drawings]

FIG. 1 is a block diagram illustrating the structure of a conventional apparatus for automatically controlling the output of a laser diode;

FIG. 2 is a flowchart showing a method of automatically controlling the output of a laser diode according to the present invention;

FIG. 3 is a block diagram illustrating the structure of an apparatus for automatically controlling the output of the laser diode according to the present invention;

FIG. 4 is a block diagram for describing a preferred embodiment of the apparatus for automatically controlling the output of the laser diode according to the present invention;

FIG. 5 is a timing chart showing the operation of the apparatus shown in FIG. 4; and

FIG. 6 is a diagram of an operating mode of an operation unit shown in FIG. 4.

[Detailed Description of the Invention]

[Object of the Invention]

[Technical Field of the Invention and Related Art prior to the Invention]

The present invention relates to an optical recording/regenerating apparatus, and more particularly, to a method and an apparatus for automatically controlling the optimum output of a laser diode.

In the information-oriented or multimedia society we live in today, recording media accommodating a large amount of data is required. These recording media

include CD-Rs, CD+RWs, magnetic optical disc drives (MODDs), digital versatile disc random access memories (DVD-RAMs), DVD-RWs, DVD+RWs, and the like. These recording media use laser diodes and thus control of the optimum output of the laser diodes determines their performances. Also, different types of recording media require different types of recording pulses, which requires effective alternative methods.

FIG. 1 shows a block diagram of a conventional apparatus for automatically controlling the output of a laser diode. Referring to FIG. 1, the apparatus includes an interface 110, a decoder 120, an address controller 130, a pulse generator 140, an ALPC block 150, an LD driver 160, and a delay unit 170.

The interface 110 communicates with an outer processor, e.g., a microprocessor of a computer to transceive information on recording/regenerating data, control data, and modes used. The decoder 120 includes an address decoder 121, a register unit 122, and a demultiplexer 123 for selecting one of a variety of registers included in the register unit 122. The address controller 130 can include a variety of registers and sub-blocks for realizing the functions of the address controller 130.

The laser diode driver 160 is a device switching at a high speed and may include generally-used ICs or ASICs.

The pulse generator 140 generates signals for generating and controlling recording pulses to form a domain on a recording medium corresponding to data to be recorded. Such pulse generator is disclosed in detail in Korean Patent No. 99-30485 (filed 3 June 1999, entitled : A method and an Apparatus for Generating Recording Pulses Appropriate for Various Types of Optical Recording Media) filed by the present applicant. Delay unit 170 is for delay, LD represents a laser diode, and PD represents a photo diode.

The ALPC block 150 detects the difference between a basic power value from the decoder 120 and a current power value from the PD and controls the laser diode driver 160 based on the detected result.

The operation of the apparatus shown in FIG. 1 will be described. It is assumed that the interface 110 has been already constituted because it depends on the configuration of an optical disk unit.

The decoder 120 selects and keeps target power values, e.g., basic power values such as read power, eraser power, and peak power. At least three or more basic power values selected, e.g., read power, eraser power, and peak power, are input into the ALPC block 150. A first D/A converter 151 converts each basic power value to an analog signal value and transmits it to a comparator 152.

Meanwhile, a signal output from the PD is transmitted to the comparator 152 via a buffer (not shown). Here, the pulse generator 140 generates a signal and then transmits it to the comparator 152 via the delay unit 170 to control the operation of the comparator 152.

An up/down counter 153 counts up or down based on the results of the comparator 152. The output of the up/down counter 153 is selected by a second demultiplexer 154, converted to an analog signal via a second D/A converter 155, and transmitted to the LD driver 160.

A control signal is input into the LD driver 160 to control each power level from the ALPC block 150 and each power level from the pulse generator 140.

In the apparatus shown in FIG. 1, the up/down counter 153 is used for comparing and controlling the basic power values and the current power values fed back. However, since the speed of recording and regenerating media has increased significantly, the operating speed of the up/down counter 153 limits the control speed and range. Also, as the recording speed increases, the width of recording pulses gets narrower and more complicated.

[Technical Goal of the Invention]

To solve the above problems, it is an object of the present invention to provide a method of automatically controlling the optimum output of a laser diode.

It is another object of the present invention to provide an apparatus for

automatically controlling the output of the laser diode.

[Structure and Operation of the Invention]

Accordingly, to achieve the above first object, there is provided a method of automatically controlling the output of a laser diode based on the results of a comparison between the current power value of an optical signal output from a laser diode and a basic power value. The method includes: sampling the current power value of the optical signal output from the laser diode; comparing the sampled current power value with the basic power value; and controlling the output of the laser diode based on the compared results.

To achieve the second object, there is provided an apparatus for automatically controlling the output of a laser diode based on the results of a comparison between the current power value of an optical signal output from a laser diode and a basic power value. The apparatus includes: a sampler for sampling the current power value output from the laser diode; a register unit for storing the output of the sampler; a basic register unit for storing a basic value; an operation unit for outputting a target output value applied to the laser diode based on the current power value and the basic power value stored in the register unit and the basic register unit; and a pulse generator for generating a control signal controlling the storing timing of the register unit based on recording data to be recorded by the laser diode.

Preferably, the apparatus further includes: a pulse generator for generating a multiplexing control signal representing a sector to which a peak power, a read power, and a bias power are applied based on recording control signals, each of which controls the peak power, the read power, and the bias power, and for generating a demultiplexing control signal based on the recording data; registers of the register unit, basic registers of the basic register, and operators of the operation unit corresponding to the types of powers, such as the peak power, the read power, the bias power, required for the laser diode; a demultiplexer for demultiplexing output of the sampler based on the demultiplexing control signal and then transmitting it to the registers of the

register unit; and a multiplexer for multiplexing outputs of the operators of the operation unit based on the multiplexing control signal and then transmitting them to the laser diode.

Preferred embodiments of the present invention will now be described with reference to the attached drawings.

Hereinafter, the structure and operation of an apparatus for automatically controlling the output of a laser diode according to the present invention will be described in detail with reference to the attached drawings.

In the apparatus shown in FIG. 1, the up/down counter 153 is used for comparing and controlling the basic power values and the current power values fed back. However, since the speed of recording and regenerating of media continues to increase, the operating speed of the up/down counter 153 limits controlling speed and range. Also, as the recording speed increases, the width of recording pulses gets narrower and more complicated. Thus, steps are required to be taken to solve these problems.

The present invention provides a method of automatically controlling the output of a laser diode by which the output of the laser diode is sampled and held for a desired period at a desired location and then compared with basic power values.

FIG. 2 is a flowchart showing a method of automatically controlling the output of an auto laser diode according to the present invention. The method shown in FIG.2 includes a sampling and holding step S202, a comparing step S204, and a controlling step S206. In the sampling and holding step S202, the output of the laser diode is sampled and held. In the comparing step S204, current power values and basic power values of the laser diode sampled in the sampling and holding step S202 are compared with each other and then the differences between them are obtained. In the controlling step S206, the output of the laser diode is controlled based on the value differences obtained from the comparing step S204.

Since the conventional apparatus shown in FIG. 1 uses the up/down counter while the method shown in FIG. 2 does not use a up/down counter, the responsive

speed for controlling the output of the laser diode increases. Thus, the method is applied to recording media of high density and capacity.

FIG. 3 is a block diagram of the structure of an apparatus for automatically controlling the output of a laser diode according to the present invention. Referring to FIG. 3, the apparatus includes a photo diode (PD) & I/V amplifier 302, an analog/digital converter 304, a register unit 308, a basic register unit 310, an operation unit 312, a digital/analog converter 316, a laser diode 318, a pulse generator 320, an NRZI detector 322, and a controller 324.

The output of the laser diode 318 is controlled by the digital/analog converter 316 and the output level thereof is detected and current-to-voltage-converted by the PD & I/V amplifier 302. One chip consisting of the PD and I/V amplifier 302 is produced but a photo diode and an I/V amplifier separated from each other can be used. The output of the PD & I/V amplifier 302 indicates the current power value of the laser diode 318 and has delayed waveforms of recording pulses applied to the laser diode 318. Here, the delayed amount depends on the operating characteristics of the laser diode 318 and the PD & I/V amplifier 302 and is rarely changed after the configuration of the apparatus.

The recording pulse is a multi-pulse including a first pulse, a multi-pulse train, a last pulse, and a cooling pulse. Each pulse has any one of read power level, peak power level, bias 1 power level, bias 2 power level, and bias 3 power level. In other words, the level of the recording pulse is changed on the time axis and becomes any one of the read power level, the peak power level, the bias 1 (or erase) power level, the bias 2 (or cooling) power level, and the bias 3 (or bottom) power level.

The recording pulse is made on the basis of a non-return-to-zero inverted (NRZI) signal. The rising/falling position, width, and power level of each pulse constituting the recording pulse are changed based on the interrelation between front and back spaces of a current mark.

The pulse generator 320 generates a power level control signal turning on/off each power level based on the NRZI signal and the interrelation between the spaces of

the mark. The power level control signal includes a lead control signal, a peak control signal, a bias 1 control signal, a bias 2 control signal, and a bias 3 control signal each controlling the read power level, the peak power level, the bias 1 power level, the bias 2 power level, and the bias 3 power level.

The analog/digital converter 304 samples the output of the PD & IV amplifier 302 at a predetermined point, obtains current power values, and transmits them to the operation unit 312 via the register unit 308.

The operation unit 312 compares the sampled current power values with the basic power values and controls the output of the laser diode 318 based on the compared results. Here, the basic power values store a value which is output from the controller 324 when the apparatus shown in FIG. 2 is initialized, and the stored value depends on the types of media. In detail, the operation unit 312 changes the level of driving power which is supplied to the laser diode 318, based on the compared results.

FIG. 4 is a block diagram for describing a preferred embodiment of an apparatus for automatically controlling a laser diode according to the present invention. The components of the apparatus shown in FIG. 4 that have the same reference numerals as those of the apparatus shown in FIG. 2 have the same operating functions and thus a detailed description will be omitted. In FIG. 4, the solid line represents the flow of data and the broken line represents the flow of a control signal. The apparatus shown in FIG. 4 includes a photo diode (PD) & I/V amplifier 302, an analog/digital converter 304, a demulitplexer 306, a register unit 308, a basic register unit 310, an operation unit 312, a multiplexer 314, a digital/analog converter 316, a laser diode 318, a pulse generator 320, an NRZI detector 322, and a controller 324.

The basic register unit 310 stores a basic power value output from the controller 324. The basic power value depends on the format of the disk, e.g., CD, CD-R, DVD, DVD-RW, and DVD+RW, the types of media, and makers, and is transmitted to the controller 324 via an interface (not shown).

The output of the PD & I/V amplifier 302 represents the current power value of the laser diode 318. The PD & I/V amplifier 302 is a variable gain amplifier, and the gain is set depending on operating modes and the existence of land/groove.

The analog/digital converter 304 corresponds to a sampling means in the summary of the present invention and converts the output of the PD & I/V amplifier 302 to an analog/digital signal. The output of the analog/digital converter 304 is transmitted to the operation unit 312 via the demultiplexer 306 and the register unit 308.

The pulse generator 320 generates a demultiplexing control signal controlling the operation of the demultiplexer 306. The pulse generator 320 includes a plurality of delay units and gates (not shown), delays and logically operates a power level control signal, and generates a demultiplexing control signal transmitted to the demultiplexer 306 and a multiplexing control signal transmitted to the multiplexer 314.

It can be easy to select a sector for sampling desired power level from the laser diode 318 using the delay units and the gates.

Meanwhile, the pulse generator 320 generates a lead control signal, a peak control signal, a bias 1 control signal, a bias 2 control signal, and a bias 3 control signal, and the NRZI detector 322 determines the rising/falling positions of these signals and the width of pulses.

The NRZI detector 322 receives an NRZI signal, detects the interrelation between the current mark and the front and back spaces of the mark, and transmits the detected results to the pulse generator 320, thereby determining the rising/falling position of each control signal and the width of pulses.

The controller 324 transmits the basic power values received via the interface (not shown) to the basic register unit 310, and controls the gain of the PD & I/V amplifier 302 based on information on operating modes, types of media, formats of disks, and the existence of a land/groove.

A detailed description of the operation of the apparatus shown in FIG. 4 is as follows. In other words, auto power control of a laser diode means that the power of a laser is controlled when recording/regenerating on optical disks. Since the output of

the laser varies based on temperature, the output of the laser needs to be uniformly controlled based on operating temperature. This is called an auto laser output control. The power of a laser diode is automatically controlled to stabilize the output of the laser based on temperature variation, and prevent the deterioration of recording based on heat accumulation in a multitrain recording method.

The NRZI detector 322 receives NRZI data and detects data to be recorded. The NRZI detector 322 detects the predetermined interrelation between the current mark and the front and back spaces of the mark and outputs the detected results to the pulse generator 320. In an adaptive control method, the length of a mark and the combination of spaces are classified into a few groups based on the lengths of the mark and spaces. The classified groups each have different power levels, the rising/falling positions, and the widths of the pulses which constitute recording pulses. Also, the power levels of the pulses vary based on the energy of the NRZI signal. Here, the energy represents the number exchanged between 0 and 1 for a unit time.

The pulse generator 320 generates power level control signals ((c) ~ (f) shown in FIG. 5) for forming recording pulses ((b) shown in FIG. 5) appropriate for the detected results of the NRZI detector 322, the laser diode from the controller 324, the types of media and recording speed.

The analog/digital converter 304 samples the output of the PD & I/V converter 302. The output of the analog/digital converter 308 is transmitted to the register unit 308 via the demultiplexer 306.

The register unit 308 includes registers 308a through 308e corresponding to the power required for controlling the output of the laser diode.

A 2.6 Gbyte DVD needs three power levels of read power, peak power, and bias power, and a 4.7 Gbyte DVD needs five power levels of a read power, a peak power, a bias 1 power(erase power), a bias 2 power (cooling power), and a bias 3 power (bottom power).

The storing operations of the registers 308a through 308e are synchronized with the demultiplexing control signal.

The basic register unit 310 and the operation unit 312 each include basic registers 310a through 310e and operators 312a through 312e corresponding to the number of the registers 308a through 308e of the register unit 308.

The operators 312a through 312e of the operation unit 312 compare the current power values stored in the registers 310a through 310e with the basic power values stored in the basic registers 310a through 310e based on operation modes determined by the controller 324, and controls the power level of the laser diode 318 based on the compared results.

The outputs of the operators 312a through 312e of the operation unit 312 drive the laser diode 318, and the output level of the laser diode 318 is fed back to the analog/digital converter 304 via the PD & I/V amplifier 302.

Compared with the conventional up/down counter, which increases/decreases the target value by one bit, an up/down counter of the apparatus shown in FIG. 4 increases/decreases all of the bits at the same time, thereby increasing the speed of tracking. Thus, the apparatus shown in FIG. 4 can efficiently control the laser power based on the types of media and recording speed.

The registers of the register unit 308, the basic registers of the basic register 310, and the operators of the operation unit 312 are provided depending on the required number of power levels, and five power levels of the read power, the peak power, the bias 1 power, the bias 2 power, and the bias 3 power are used in FIG. 3.

FIG. 5 is a waveform diagram showing the operation of the apparatus shown in FIG. 4. In FIG. 5, (a) and (b) represent an input NRZI signal and recording pulses output from the laser diode, respectively. The waveforms of the recording pulses vary based on the types of media, recording speed, and disk makers. These recording pulses give an example to a 4.7 GByte DVD_RAM, and the waveforms of recording pulses also vary based on the interrelation between mark and space.

(c) represents a signal input to the analog/digital converter 304 from the PD & I/V amplifier 302. In other words, a portion of an optical signal output from the laser diode 318 is input to a photo diode (PD), and the output of the photo diode (PD), i.e., current

is converted to voltage and simultaneously amplified to an appropriate gain. Thus, the optical power value output from the laser diode 318 can be obtained by detecting the signal.

(d) represents a control signal for controlling the read power level, (e) represents a control signal for controlling the peak power level, (f) represents a control signal for controlling the erase power level, (g) represents a control signal for controlling the cooling power level, and (h) represents a control signal for controlling the bottom power level. Recording pulses such as (b) can be generated from the combination of the control signals shown in (d), (e), (f), and (g).

FIG. 6 shows the operation mode of the operation unit 312 shown in FIG. 4. The mirror or gap sector in (a) is generated in the case of DVD-RAMs, and others represent unused sectors or sectors maximally/minimally controlling a focus servo. Continuous control is performed in (b), and at this time, optical power may be changed due to sampling noise or outer noise. In the case of (c), a particular sector, i.e., the mirror or gap section in (a), is controlled and other sectors are held at the last controlled value, thereby reducing variations in optical power (sub-ALPC mode). In the case of (d), each controlled value is not reflected but it is averaged and the averaged value is reflected, thereby reducing variations in optical power (Average ALPC mode). Here, the same effect as that exhibited when using a low-pass filter can be obtained. In the case of (e), ways in (b) and (d) are simultaneously used, variations in average are reflected in a particular sector, and the last value is held in other sectors, thereby minimizing variations in optical power due to sampling noise or outer noise.

The apparatus shown in FIG. 4 serves as both an apparatus for automatically controlling the output of a conventional laser and a driver for driving a laser diode. Also, the apparatus shown in FIG. 4 may be installed in a pickup and, and in a case where it is built in the pickup, the limit in the speed of an interface can be eliminated and the number of parts needed for the interface can be reduced.

In general, since the output of a photo diode is a minute signal, it is easily affected by the influx and interference of noise during interfacing. However, in a case

where the photo diode is installed on a pickup, as shown in the apparatus of FIG. 4, the influx and interference of noise can be prevented.

Accordingly, the apparatus for automatically controlling the output of a laser diode according to the present invention can be effectively adapted to an optical recording/regenerating apparatus of high speed and high capacity, and can be attributed to the performance improvement and downsizing of the optical recording/reproducing apparatus.

Although the invention has been described with reference to a preferred embodiment, it will be apparent to one of ordinary skill in the art that modifications of the described embodiment may be made without departing from the spirit and scope of the invention.

[Effect of the Invention]

Accordingly, the apparatus for automatically controlling the output of a laser diode according to the present invention can be effectively adapted to an optical recording/regenerating apparatus of high speed and high capacity, and can be attributed to the performance improvement and downsizing of the optical recording/reproducing apparatus.

What is claimed is:

1. A method of automatically controlling the output of a laser diode based on the results of a comparison between the current power value of an optical signal output from a laser diode and a basic power value, the method comprising:

sampling the current power value of the optical signal output from the laser diode;

comparing the sampled current power value with the basic power value; and

controlling the output of the laser diode based on the compared results.

2. An apparatus for automatically controlling the output of a laser diode based on the results of a comparison between the current power value of an optical signal output from a laser diode and a basic power value, the apparatus comprising:

a sampler for sampling the current power value output from the laser diode;

a register unit for storing the output of the sampler;

a basic register unit for storing a basic value;

an operation unit for outputting a target output value applied to the laser diode based on the current power value and the basic power value stored in the register unit and the basic register unit; and

a pulse generator for generating a control signal controlling the storing timing of the register unit based on recording data to be recorded by the laser diode.

3. The apparatus of claim 2, wherein the sampler is an analog/digital converter.

4. The apparatus of claim 2, further comprising:

a pulse generator for generating a multiplexing control signal representing a sector to which a peak power, a read power, and a bias power are applied based on recording control signals, each of which controls the peak power, the read power, and the bias power, and for generating a demultiplexing control signal based on the recording data;

registers of the register unit, basic registers of the basic register, and operators of the operation unit corresponding to the peak power, the read power, the bias power required for the laser diode;

a demultiplexer for demultiplexing output of the sampler based on the demultiplexing control signal and then transmitting it to the registers of the register unit; and

a multiplexer for multiplexing outputs of the operators of the operation unit based on the multiplexing control signal and then transmitting them to the laser diode.

5. The apparatus of claim 2, further comprising a digital/analog converter for converting the output of the multiplexer to a digital/analog signal and then transmitting it to the laser diode.

6. The apparatus of claim 2, wherein the apparatus is built in a pickup.

FIG. 1

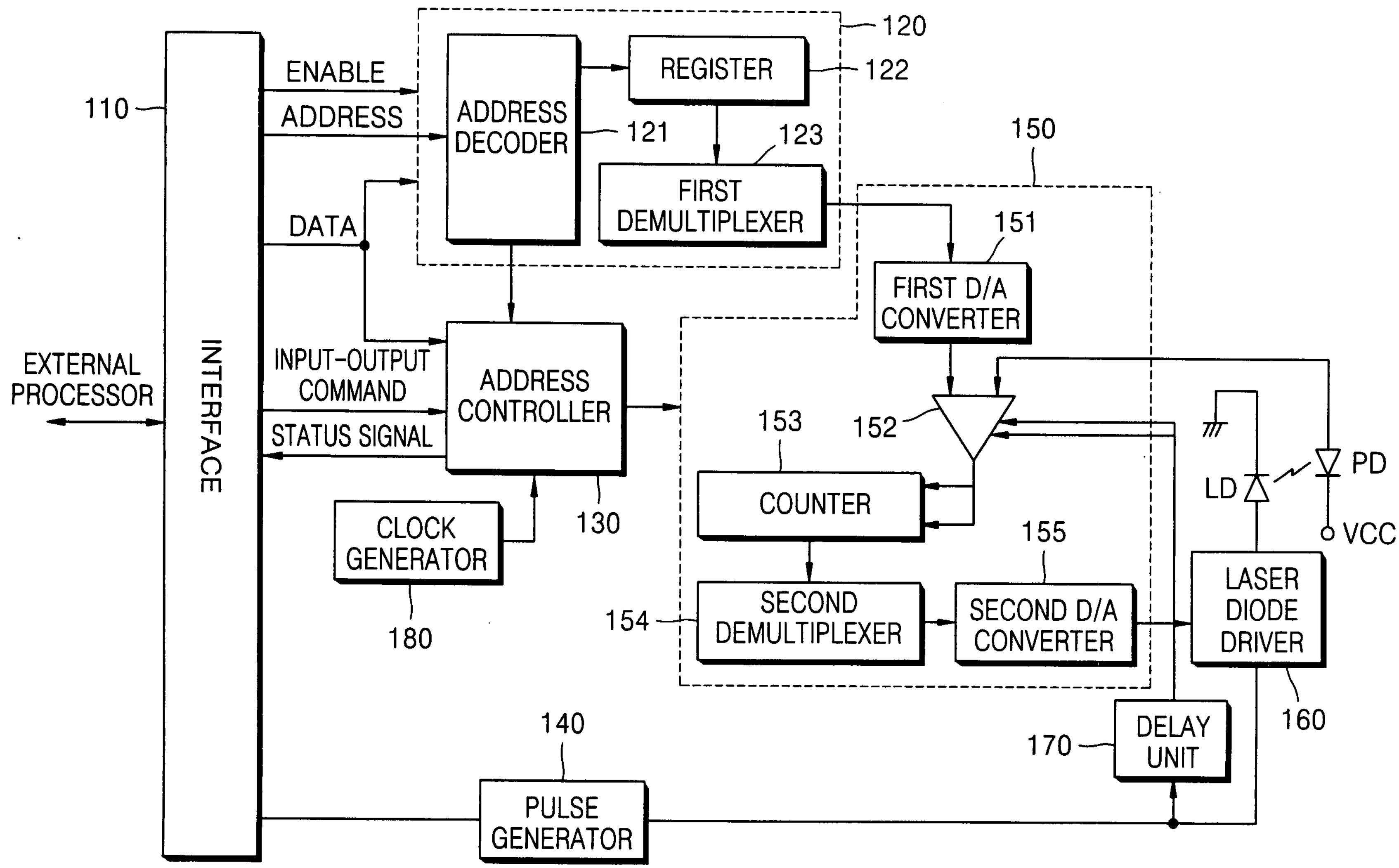

110
EXTERNAL PROCESSOR
INTERFACE
ENABLE
ADDRESS
DATA
INPUT-OUTPUT COMMAND
STATUS SIGNAL
120
ADDRESS DECODER
121
REGISTER
122
FIRST DEMULTIPLEXER
123
ADDRESS CONTROLLER
130
CLOCK GENERATOR
180
150
FIRST D/A CONVERTER
151
152
COUNTER
153
SECOND DEMULTIPLEXER
154
SECOND D/A CONVERTER
155
LD
PD
VCC
LASER DIODE DRIVER
160
DELAY UNIT
170
PULSE GENERATOR
140

FIG. 2

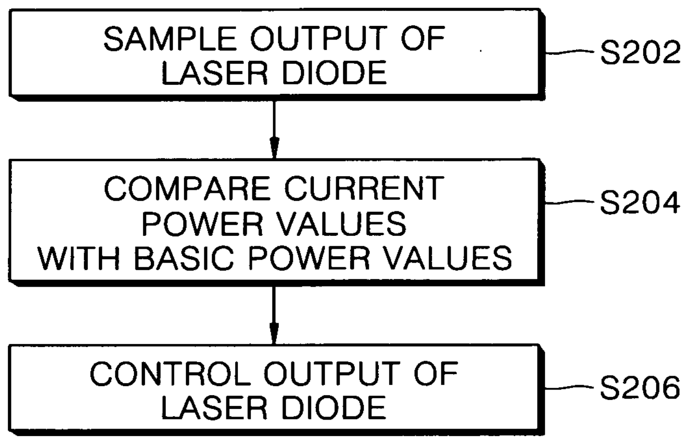

SAMPLE OUTPUT OF LASER DIODE
S202
COMPARE CURRENT POWER VALUES WITH BASIC POWER VALUES
S204
CONTROL OUTPUT OF LASER DIODE
S206

FIG. 3

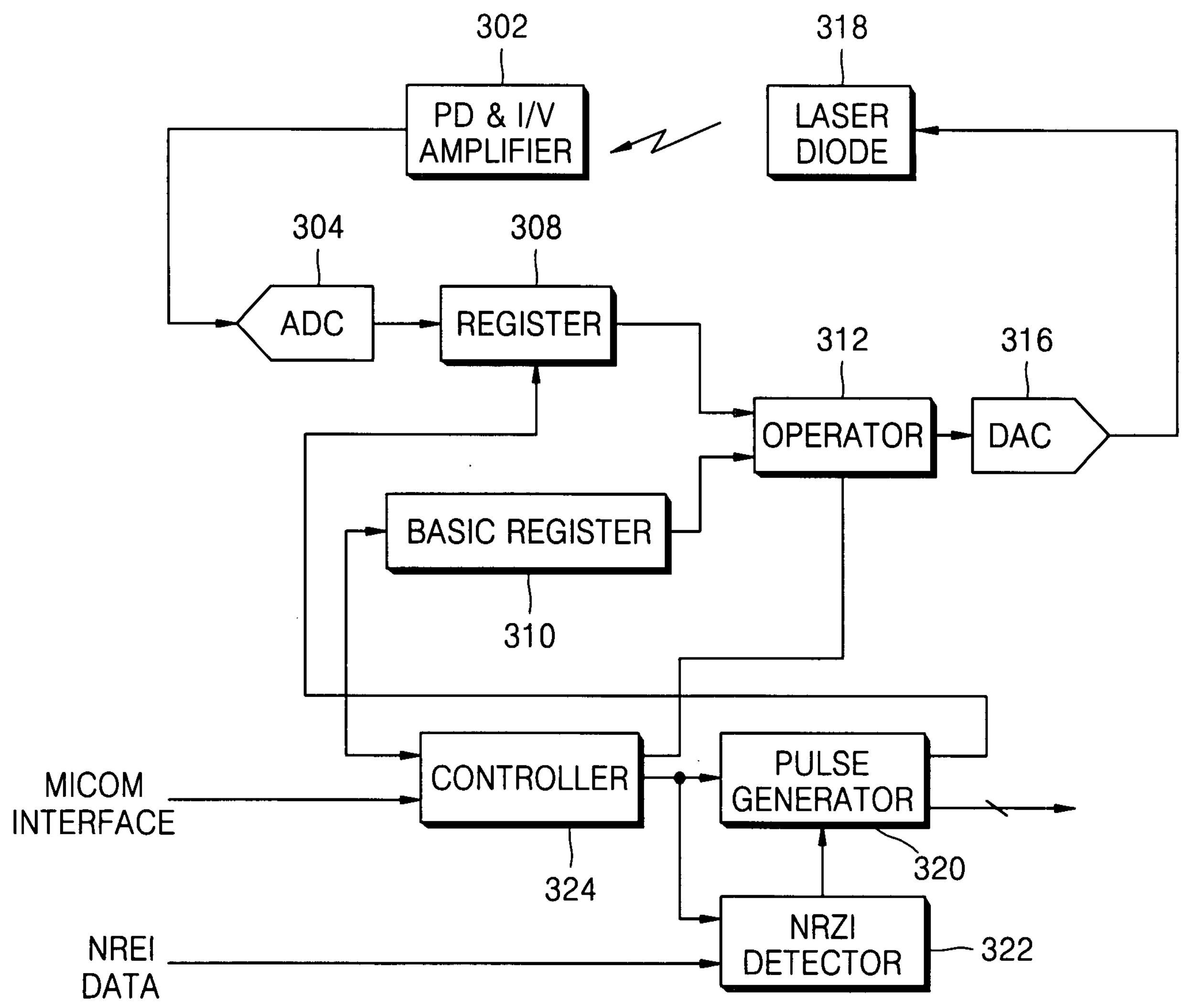
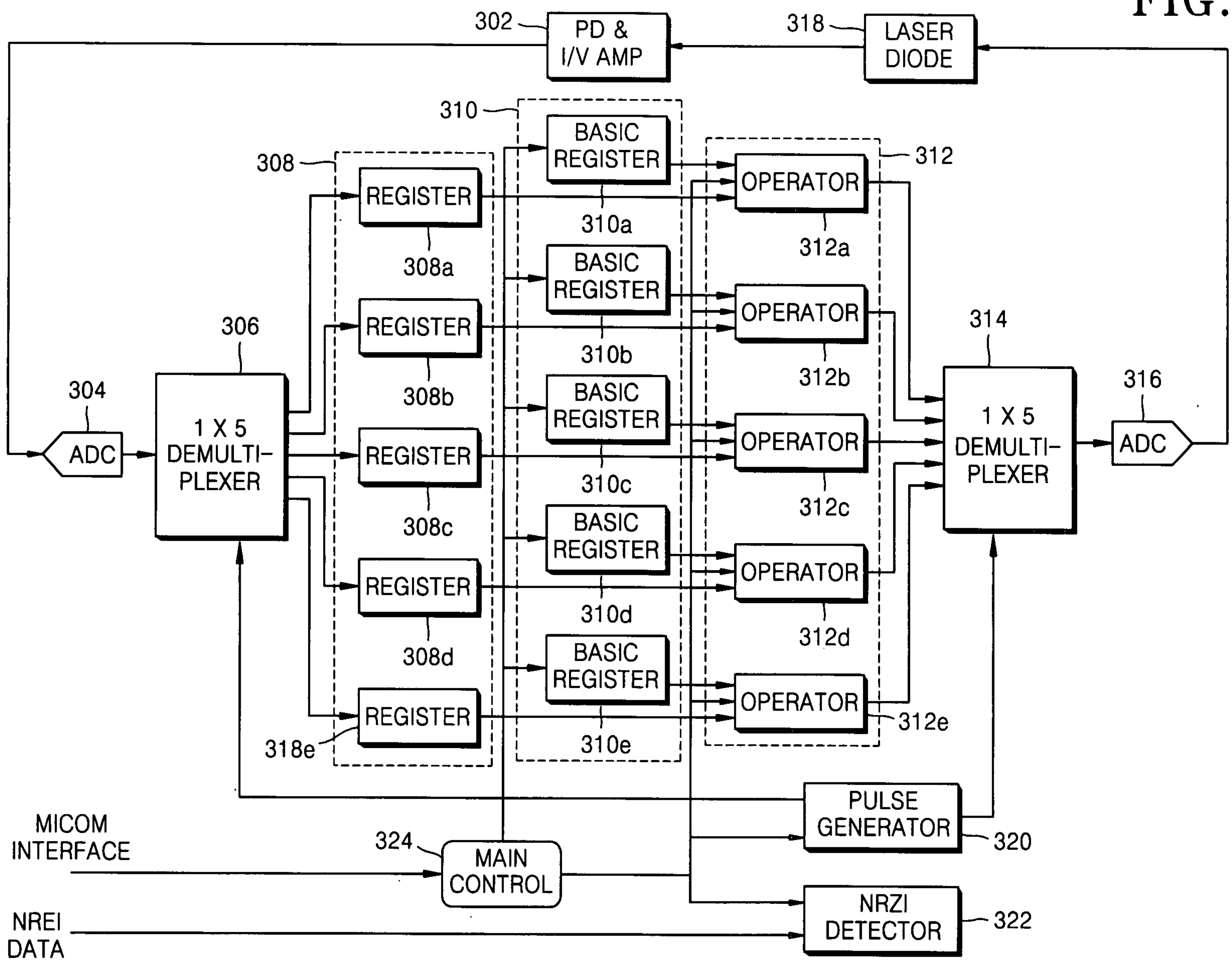

302
PD & I/V AMPLIFIER
318
LASER DIODE
304
ADC
308
REGISTER
312
OPERATOR
316
DAC
BASIC REGISTER
310
MICOM INTERFACE
CONTROLLER
324
PULSE GENERATOR
320
NREI DATA
NRZI DETECTOR
322

FIG. 4



302
PD & I/V AMP
318
LASER DIODE
310
BASIC REGISTER
310a
310b
310c
310d
310e
308
REGISTER
308a
308b
308c
308d
318e
312
OPERATOR
312a
312b
312c
312d
312e
306
1 X 5 DEMULTI-PLEXER
304
ADC
314
1 X 5 DEMULTI-PLEXER
316
ADC
PULSE GENERATOR
320
NRZI DETECTOR
322
324
MAIN CONTROL
MICOM INTERFACE
NREI DATA

FIG. 5

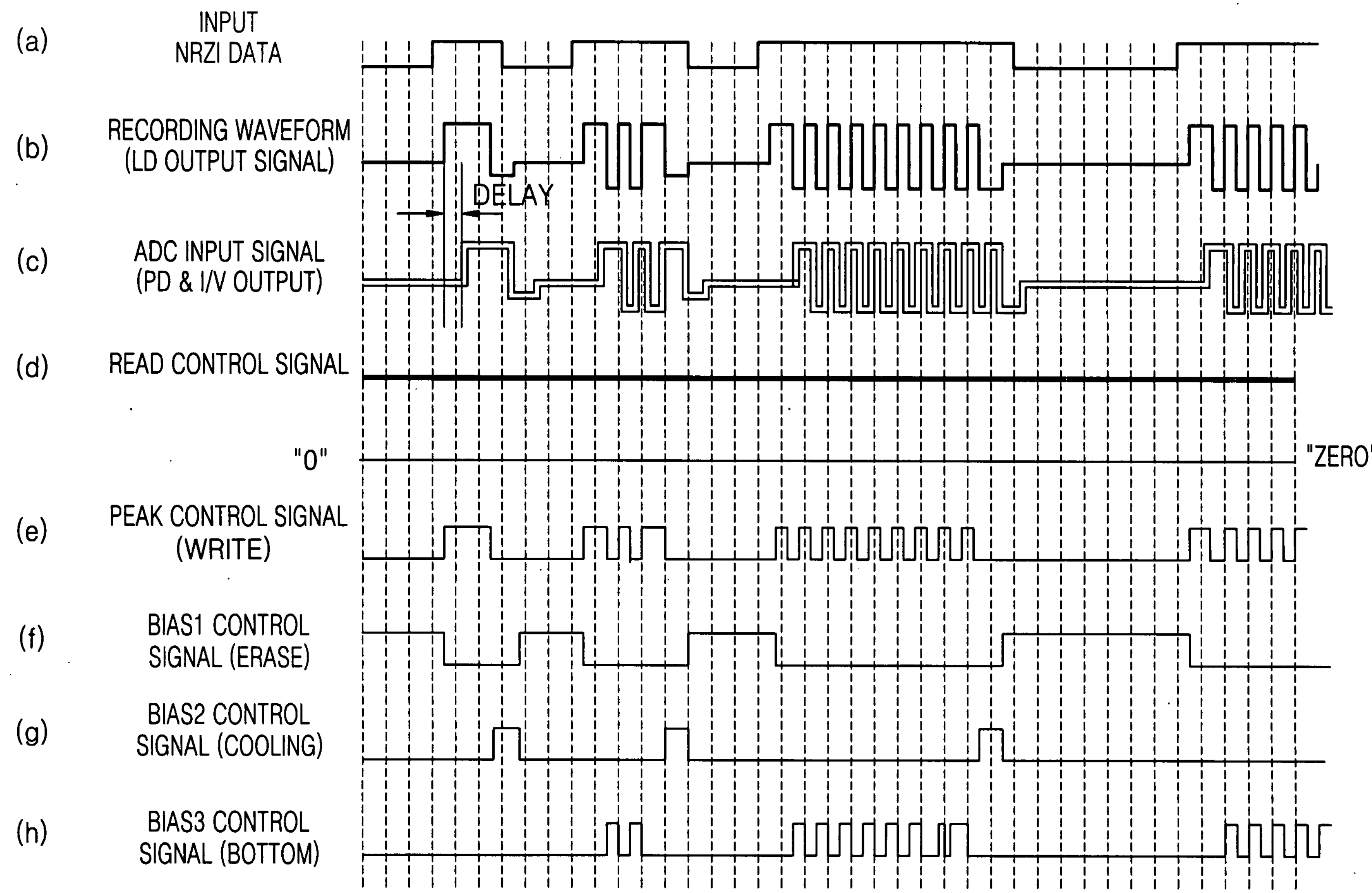
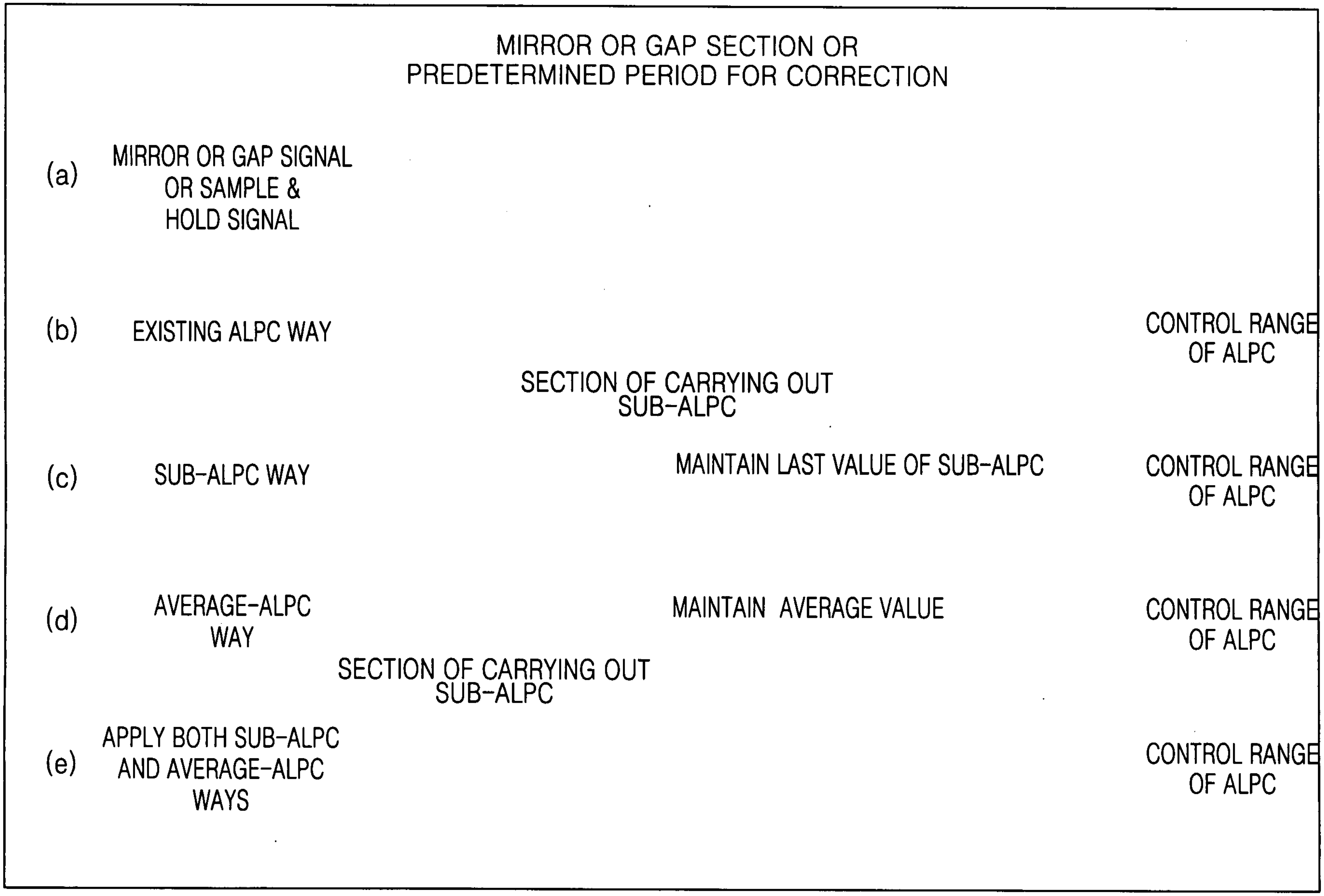

(a)
INPUT NRZI DATA
(b)
RECORDING WAVEFORM (LD OUTPUT SIGNAL)
DELAY
(c)
ADC INPUT SIGNAL (PD & I/V OUTPUT)
(d)
READ CONTROL SIGNAL
"0"
"ZERO"
(e)
PEAK CONTROL SIGNAL (WRITE)
(f)
BIAS1 CONTROL SIGNAL (ERASE)
(g)
BIAS2 CONTROL SIGNAL (COOLING)
(h)
BIAS3 CONTROL SIGNAL (BOTTOM)

FIG. 6


MIRROR OR GAP SECTION OR
PREDETERMINED PERIOD FOR CORRECTION
(a)
MIRROR OR GAP SIGNAL OR SAMPLE & HOLD SIGNAL
(b)
EXISTING ALPC WAY
CONTROL RANGE OF ALPC
SECTION OF CARRYING OUT SUB-ALPC
(c)
SUB-ALPC WAY
MAINTAIN LAST VALUE OF SUB-ALPC
CONTROL RANGE OF ALPC
(d)
AVERAGE-ALPC WAY
MAINTAIN AVERAGE VALUE
CONTROL RANGE OF ALPC
SECTION OF CARRYING OUT SUB-ALPC
(e)
APPLY BOTH SUB-ALPC AND AVERAGE-ALPC WAYS
CONTROL RANGE OF ALPC